

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



In re the application of:

Hiroaki SATOH et al

Serial Number: 09/271,447

Filed: March 18, 1999

For: PROCESS FOR FORMING A  
PATTERN OF FLUORESCENT  
SUBSTRATE AND PLASMA  
DISPLAY PANEL

Group Art Unit: 1762

Examiner: Michael Cleveland

# 18  
JCSA  
11/18/02

RECEIVED  
NOV 18 2002  
TC 1700

DECLARATION UNDER 37 CFR 1.132

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Hiroaki Satoh residing at The Nippon Synthetic Chemical Industry Co., Ltd., Central Research Laboratory, 13-1, Muroyama 2-chome, Ibaraki-shi, Osaka-fu, Japan duty deposes and says:

1. That he graduated from Faculty of Engineering, SHIBAURA INSTITUTE OF TECHNOLOGY, Tokyo, Japan, in the year 1986, and he received the degree of Master of Industrial Chemistry, from GRADUATE SCHOOL OF ENGINEERING, SHIBAURA INSTITUTE OF TECHNOLOGY, Tokyo, Japan in the year 1988;

2. That since 1988 he has been employed in the capacity of The Nippon Synthetic Chemical Industry Co., Ltd.;

3. That from 1988 he has been engaged in research and development of a photosensitive resin composition, especially of a dry

film photoresist.;

4. That he has read and is familiar with the instant application for United States Letters Patent and Office Action thereto mailed August 12, 2002.; and

5. That he has made experiments in order to show that pattern defects occur after baking is carried out, when a photosensitive resin is used for a fluorescent substance-containing resin composition layer to impart photo-polymerization property.

6. Experiments were carried out by the following procedure according to a working example in the present application.

**Preparation of compositions (A), (B), and (A')**

**[Resin composition (A)]**

A resin composition (A) was prepared by using 60 parts by weight (hereinafter referred to as "parts") of the following acrylic polymer (a), 30 parts of the following fluorescent substance (b) (red, green, blue were separately employed), and 40 parts of the ethylenically unsaturated compound.

**Acrylic polymer (a)**

copolymer of methyl methacrylate, n-butyl methacrylate, 2-ethylhexyl acrylate and methacrylic acid, a ratio thereof being 50/15/10/25 based on weight

(glass transition temperature 75°C,

weight average molecular weight 60000, acid number 163 mgKOH/g)

**Fluorescent substance (b)**

(Y, Gd, Eu)BO<sub>3</sub> (red)

(emission wavelength : 593 nm, 610 nm, 626 nm,

particle diameter : 2 - 4  $\mu\text{m}$ , specific gravity : 5.1)

$(\text{Zn}, \text{Mn})_2\text{SiO}_4$  (green)

(emission wavelength : 529 nm, particle diameter : 2 - 6  $\mu\text{m}$ ,  
specific gravity : 4.2)

$(\text{Ba}, \text{Eu})\text{MgAl}_{10}\text{O}_{17}$  (blue)

(emission wavelength : 451 nm, particle diameter : 2 - 6  $\mu\text{m}$ ,  
specific gravity : 3.8)

Ethylenically unsaturated compound

glycerin triacrylate

**[Photosensitive resin composition (B)]**

A photosensitive resin composition (B) was prepared by using 60 parts of the following base polymer (f), 40 parts of the following ethylenically unsaturated compound (g) and 7.87 parts of the following photo-polymerization initiator (h).

Base polymer (f)

copolymer of methyl methacrylate, n-butyl methacrylate,

2-ethylhexyl acrylate and methacrylic acid, a ratio thereof being 50/15/10/25 based on weight

(glass transition temperature 75°C, weight average molecular weight 60000, acid number 163 mgKOH/g)

Ethylenically unsaturated compound (g)

tetraethylene glycol dimethacrylate      25 parts

glycerin triacrylate      15 parts

Photo-polymerization initiator (h)

benzophenone      7.5 parts

N,N'-tetramethyl-4,4'-diaminobenzophenone      0.27 part

ethyl p-dimethylaminobenzoate	0.1 part
-------------------------------	----------

**[Photosensitive resin composition (A')]**

A photosensitive resin composition (A') was prepared in the same manner as in the resin composition (A) except for mixing 3.6 parts of the following photo-polymerization initiator (h).

Photo-polymerization initiator (h)

benzophenone	3.5 parts
N,N'-tetramethyl-4,4'-diaminobenzophenone	0.05 part
ethyl p-dimethylaminobenzoate	0.05 part

**Experiment 1**

Fluorescent pattern was formed by the following procedure, which was the same as that of the working examples in the present specification.

The obtained resin composition (A) was applied to a polyester film having 20  $\mu\text{m}$  thickness by using an applicator having 10 mil gap. After standing at a room temperature for one and half minute, the film was dried respectively for 3 minutes at 60, 90, 110°C to form the resin composition (A) layer having 50  $\mu\text{m}$  (a protecting film was not covered).

In case of the resin composition (A) layer, the layers containing red, green, or blue fluorescent substance were respectively prepared.

The photosensitive resin composition (B) layer having 70 $\mu\text{m}$  was prepared by using the photosensitive resin composition (B) in the same manner as mentioned above (a protecting film was not covered).

By using the obtained laminate of (A) layer and (B) layer, the

pattern of the fluorescent substance was formed according to the following process.

(Formation of the resin composition (A) layer and the photosensitive resin composition (B) layer)

To the PDP substrate (200 mm×200 mm×2 mm) preheated at 60°C in an oven having the formed cell (stripe pattern of  $T_0$  120  $\mu$ m, width 45  $\mu$ m and slit 180  $\mu$ m), the resin composition (A) layer (laminated film) was laminated at the following condition; temperature of laminate roll 120°C, pressure of roll 3 kg/cm<sup>2</sup>, rate of lamination 0.5 m/min. After removing the polyester film, the photosensitive resin composition (B) layer (laminated film) was laminated thereon in the same manner as mentioned above to form the resin composition (A) layer and the photosensitive resin composition (B) layer.

(Exposure, Development)

In order to expose the inside of the cell (except for the upper part of the cell), pattern was put on the polyester film on the surface of the photosensitive resin composition (B) layer, and the film was exposed by using a 3 kw ultra-high-pressure mercury lamp of exposing machine HMW-523D made by Ork Manufacturing Co.,Ltd. The exposure value was the value of step 7 measured by a stopher 21 step sensitivity guide.

After holding time of 15 minutes after exposure, the film was developed with 1 % by weight sodium carbonate aqueous solution at 30°C for twice time of the minimum developing time to form a red line. And repeating the same operations, a green line and a blue line were formed.

(Baking)

Putting into the baking bath after development, the resin

component of the resin composition (A) layer and the photosensitive resin composition (B) layer were baked at 550°C to form the patterns of the red, green, blue fluorescent substances.

### **Experiment 2**

The pattern of the fluorescent substance was formed in the same manner as in Experiment 1 except for changing the resin composition (A) to the photosensitive resin composition (A').

### **Result and Discussion**

In the Figure, (a) and (b) are SEM (Scanning Electron Microscope) photographs showing cross section of the cell after baking, and perspective view thereof, respectively. And numeral 1 indicates the cell, and numeral 2 indicates the formed pattern of fluorescent substance

It was found by observing the photographs of Fig. 1(a) and 1(b) that the cell substrate obtained by Experiment 1 having the formed pattern of fluorescent substance 2 had no defect of pattern made by baking. And it was also found that the fluorescent substance was formed effectively and uniformly from the upper to the bottom part of the wall. These effects are based on the ground that the non-photosensitive resin composition (A) without the polymerization initiator was used for preparing the PDP substrate.

On the other hand, it was found by observing the photographs of Fig. 2(a) and 2(b) that the cell substrate obtained by Experiment 2 having the formed pattern of fluorescent substance 2 had defects of pattern made by baking. And it was also found that the fluorescent

substance was not formed effectively and uniformly, peeling off from the wall. These effects are based on the ground that the photosensitive resin composition (A') with the polymerization initiator was used for preparing the PDP substrate.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

This 1st day of November, 2002

by Hiroaki Satoh  
Hiroaki Satoh

We, the undersigned witnesses, hereby acknowledge that Hiroaki Satoh is personally known to us and did execute the foregoing Declaration in our presence on:

Date: November 1, 2002

Witness

Goshinari Akita

Date: November 1, 2002

Witness

Shinji Kashiwagi